OFFICE OF
ENGINEERING RESEARCH
OKLAHOMA STATE UNIVERSITY

PROGRESS REPORT

TO

NATIONAL AERONAUTICS

AND

SPACE ADMINISTRATION

A PROGRAM FOR SELECTING, EDITING
AND DISSEMINATING ENGINEERING
AND SCIENTIFIC SUBJECT MATTER
FROM NASA TECHNICAL REPORTS

REPORT NO. ER70-I-7

DATE: October 31, 1969

A PILOT PROGRAM FOR SELECTING, EDITING, AND DISSEMINATING ENGINEERING AND SCIENTIFIC EDUCATIONAL SUBJECT MATTER FROM NASA TECHNICAL REPORTS

PROGRESS REPORT
June 1, 1969 through October 31, 1969

COLLEGE OF ENGINEERING
OKLAHOMA STATE UNIVERSITY
STILLWATER, OKLAHOMA

Administered under Contract Number NSR 37-002-045
of the
National Aeronautics and Space Administration

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PROGRESS REPORT

I. INTRODUCTION

During this report period three additional Instructional Monographs have been completed by the authors and have been referred to the source document authors for review. Three other Instructional Monographs are in the various stages of preparation.

The proposal for two years funding of a program for continuation of Instructional Monograph preparation submitted to the American Society for Engineering Education was approved by ASEE. In August, 1969, ASEE submitted the proposal to the National Science Foundation for funding.

The Army Research Office approved the funding of a related program entitled "Pilot Program in Technology Transfer Through Educational Monographs for Self Study". This program was started at Oklahoma State University on September 1, 1969.

A proposal for continuing the NASA Pilot Program through August 31, 1970 was submitted to the National Aeronautics and Space Administration. The extension was requested to answer several unresolved, but significant, questions in the NASA Pilot Program. It was also designed to terminate the program in an orderly and definitive manner.

II. INSTRUCTIONAL MONOGRAPHS

A. Preparation of Instructional Monographs

Three Instructional Monographs were completed by the Monograph authors during this report period, They were:

TD-9, "Derivation and Application of Multicomponent Clapeyron Equation" by Wayne C. Edmister, Chemical Engineering, Oklahoma State University.

CS-9, "Decoupling in the Design and Synthesis of Multivariable Control Systems*" by L. L. Grigsby and W. A. Blackwell, Electrical Engineering, Virginia Polytechnic Institute.

CS-10, "Digital Realization of Transfer Functions*" by W. A. Blackwell, Electrical Engineering, Virginia Polytechnic Institute.

Instructional Monograph TD-9 has been typed and is being reproduced for distribution. Instructional Monographs CS-9 and CS-10 have been typed in final form and returned to the author for proofing. They will be mailed to the original author for review before being reproduced for distribution.

Two additional Instructional Monographs have been started. One is being prepared by A. Wayne Bennett, Electrical Engineering, Virginia Polytechnic Institute. Professor Bennett's Monograph is in the final stages of preparation. The other Instructional Monograph is being prepared by Nicholls Professor Wayne C. Edmister, Chemical Engineering, Oklahoma State University. Professor Edmister's Monograph is in the development stage.

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*This title is a revision of the title reported in Quarterly Report ER69-I-4, dated May 31, 1969.

Professor Bennett is presently planning to write another Instructional Monograph and will be forwarding the proposal and cost estimate to this office in the near future. Arrangements for the preparation of additional Instructional Monographs will be discussed with qualified authors as soon as a final decision is made on the proposal to extend the NASA Pilot Program to August 31, 1970.

The information in Table 1 summarizes the Instructional Monograph preparation portion of the program to date.

TABLE 1 MONOGRAPH PREPARATION

	Number of Monographs
1. Ready for distribution	24
2. Being mailed to original authors	2
3. Being written	2
4. Being researched	1
5. Developed--not reproduced because of material technical difficulties	4
	33

Future Instructional Monograph authors will be expected to furnish a summary of the document to be prepared, a list of basic source documents to be used, and an estimated cost for author preparation. Appendix IV illustrates the type of information that will be required.

B. Dissemination of Instructional Monographs

As previously reported, an active publicity program to encourage general dissemination of Instructional Monographs was not planned for this part of the NASA Pilot Program. All previous users of Instructional Monographs will be mailed updated listings of Instructional

Monographs to encourage them to use the more recent documents. This technique will be used to maintain a level of interest and encourage the evaluation of newer Instructional Monographs.

A total of 68 instructor copies were requested during this reporting period. Figure 1 illustrates the number of instructor copies requested at the end of each reporting period.

Instructional Monographs have been requested by 274 persons in 116 universities which are located in 39 states and 5 foreign countries. A total of 2,529 instructor copies and 7,371 student copies have been mailed to educators. In addition, a total of 827 instructor copies and 166 student copies have been requested by 151 practicing engineers in 62 industrial organizations.

C. Evaluation of Instructional Monographs

A total of 291 evaluation forms have been returned by 89 professors representing 57 universities located in 30 states and 69 practicing engineers working in 10 industrial organizations. The number of completed evaluations by specific Instructional Monographs is shown in Figure 2. The number of evaluations by specific Instructional Monograph received from educators is shown in Appendix I and from practicing engineers in Appendix II.

The number of evaluations increased during this reporting period by 33——from a total of 258 on May 31, 1969 to a total of 291 on October 31, 1969. This increase in the number of evaluations is attributed to the letter mailed to 178 individuals encouraging them to return evaluations on Instructional Monographs they reviewed or used in classroom situations. A copy of the letter mailed was included as Appendix III in the Quarterly Report ER69-I-4, dated May 31, 1969.

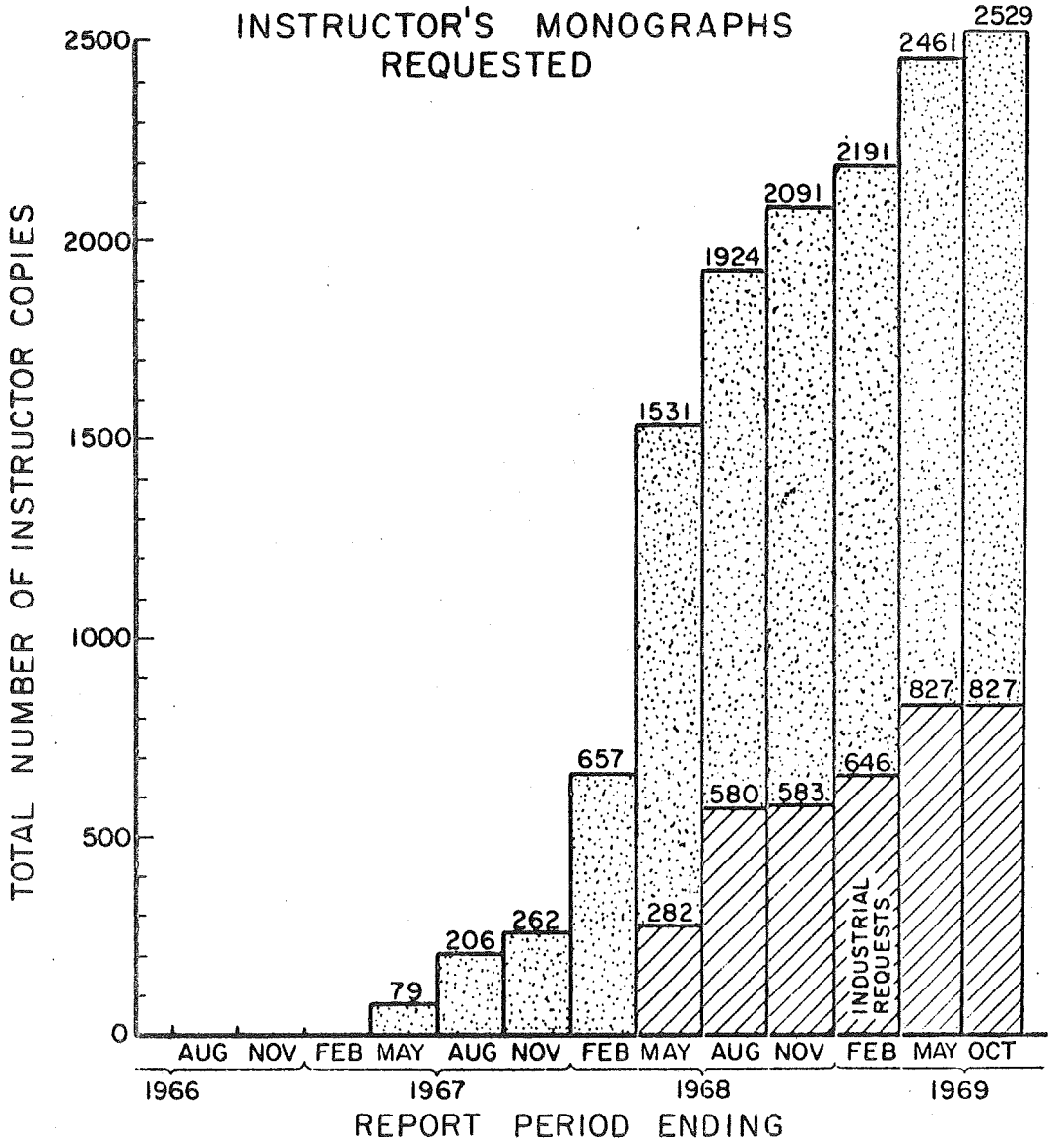
INSTRUCTOR'S MONOGRAPHS REQUESTED
TOTAL NUMBER OF INSTRUCTOR COPIES
2500
2000
1500
1000
500
0
79
206
262
657
1531
1924
2091
2191
2461
2529
282
580
583
646
827
827
INDUSTRIAL REQUESTS
AUG NOV FEB MAY AUG NOV FEB MAY AUG NOV FEB MAY OCT
1966
1967
1968
1969
REPORT PERIOD ENDING

Figure 1

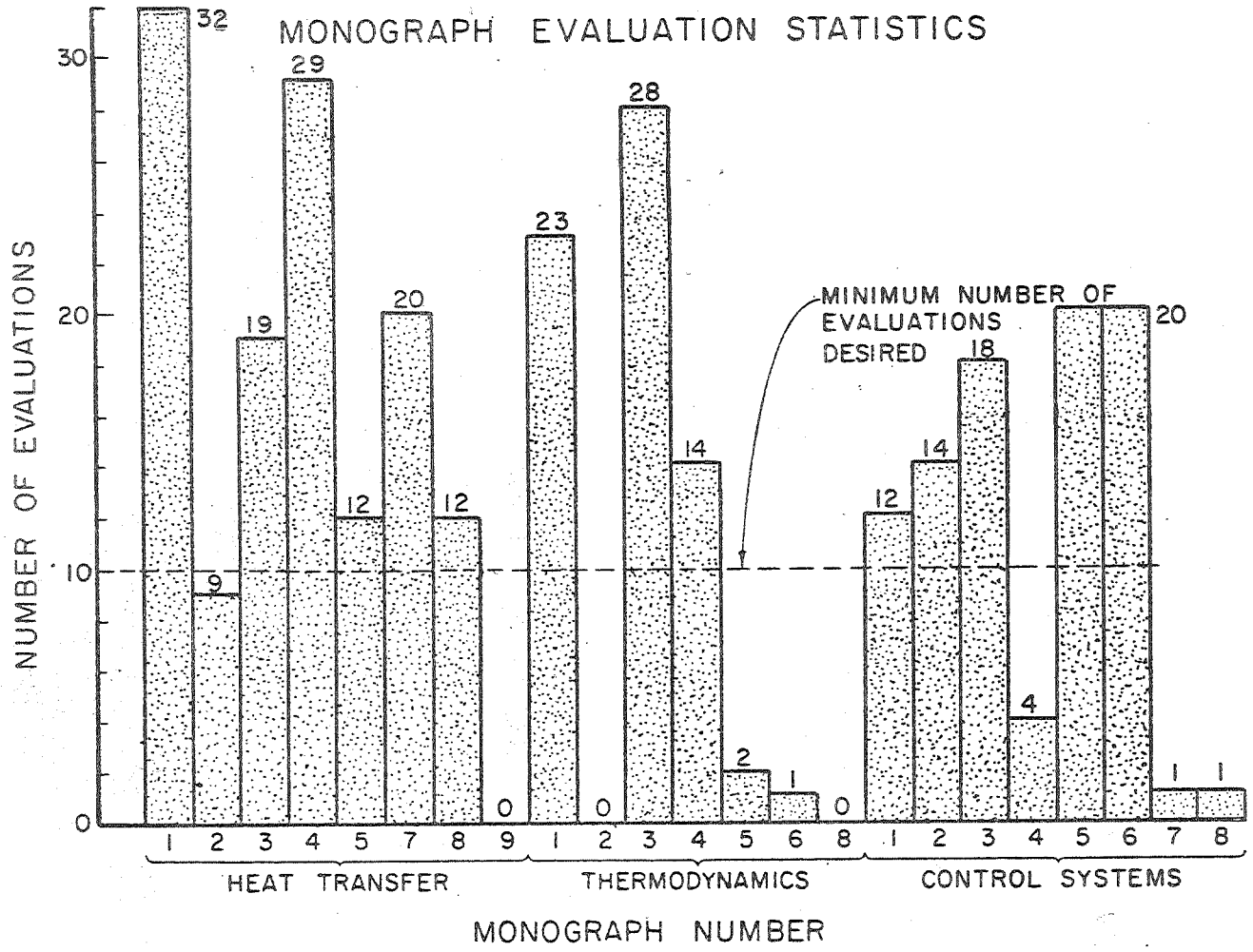
MONOGRAPH EVALUATION STATISTICS
NUMBER OF EVALUATIONS
0
10
20
30
32
9
19
29
12
20
12
0
23
0
28
14
2
1
0
12
14
18
4
20
1
1
MINIMUM NUMBER OF EVALUATIONS DESIRED
1 2 3 4 5 7 8 9
1 2 3 4 5 6 8
1 2 3 4 5 6 7 8
HEAT TRANSFER
THERMODYNAMICS
CONTROL SYSTEMS
MONOGRAPH NUMBER

Figure 2

D. Summary-Instructional Monograph Dissemination and Evaluation

The following table summarizes the dissemination and evaluation statistics for the NASA Pilot Program. The statistics illustrate the good response that has been received from individuals evaluating the existing Instructional Monographs. Thirty-two percent of the professors and 45% of the practicing engineers who have requested Instructional Monographs for review or classroom use have returned one or more evaluations. The total response on the evaluations: 37% of all individuals requesting Monographs returned one or more evaluations.

TABLE 2

INSTRUCTIONAL MONOGRAPH DISSEMINATION AND EVALUATION

Dissemination of Monographs	University	Industry	Total
A. Instructor copies mailed	1,702	827	2,529
B. Student copies mailed	7,205	166	7,371
C. Professors requesting Monographs	274		
in Universities	116		
in States	39		
in Foreign Countries	5		
D. Practicing engineers requesting Monographs		151	
in Industrial Organizations		62	

Evaluations Returned	University	Industry	Total
A. Number of evaluations returned	186	105	291
B. Professors returning evaluations	89		
in Universities	57		
in States	30		
in Foreign Countries	2		
C. Practicing engineers returning evaluations		69	
in Industrial Organizations		10	

III. PROGRAM SUPPORT - INSTRUCTIONAL MONOGRAPHS

A. American Society for Engineering Education

The proposal (ER69-T-90) prepared by Oklahoma State University was submitted to the American Society for Engineering Education in June, 1969. The proposal was approved by ASEE. The proposal was then submitted by ASEE to the National Science Foundation during August, 1969 for funding during a two year period, June 1, 1970 through May 31, 1972. Recent inquiries to the National Science Foundation indicate that the proposal is in the normal review system. It appears that a final decision on the program can not be expected before February, 1970 (NSF normally requires 6 to 8 months for review).

As previously reported, the objective of the program is to create an environment where authorities in specialized technical areas will find it feasible and desirable to convert research information into Instructional Monographs. The proposed organization will provide interaction between the universities and the professional engineering disciplines. The American Society for Engineering Education, through its Council of Technical Divisions and the cooperation of the technical societies, can provide recognized expertise in determining the appropriate general subject areas and specialized technical areas in which Instructional Monographs would be prepared. These organizations also can identify prospective authors who are qualified and respected on the basis of their contributions to the specialized technical areas.

Oklahoma State University, on the basis of the experience gained in the OSU-NASA Pilot Program, will function as the operating unit within the proposed organization. Where ASEE's and the technical societies' contribution will be informational and advisory, OSU's

contribution will be decisional. This proposed team should provide a blend of recognition and experience that should encourage authors to participate in this technology transfer technique. For further information on the details of the proposal to ASEE, refer to Oklahoma State University proposal ER69-T-90, dated June 2, 1969. (A copy has been submitted to the NASA Pilot Program Technical Monitor, National Aeronautics and Space Administration.)

B. Army Research Office

Oklahoma State University Proposal ER69-T-35, entitled "A Pilot Program in Technology Transfer Through Educational Monographs for Self Study" was approved for funding for the 18 month period commencing September 1, 1969. The $36,300 program for the Army Research Office differs from the NASA Pilot Program. The ARO program is designed to upgrade the ability of Army in-house science and engineering personnel and aid in solving problems encountered by the personnel. The program will provide the appropriate talent to prepare Instructional Monographs specifically for use as self-contained, self-study material. The NASA Pilot Program was designed to provide a means of technology transfer from research to general educational use.

C. National Aeronautics and Space Administration

An extension of Contract No. NSR 37-002-045, A Pilot Program for Selecting, Editing and Disseminating Engineering and Scientific Educational Subject Matter from NASA Technical Reports, from November 1, 1969 through August 31, 1970 was submitted on August 29, 1969. It was subsequently revised on November 11, 1969 as a result of meetings with the NASA Technical Monitor. This extension would provide the time

needed to investigate several relevant, but unanswered, questions remaining in the conceptual stage of the program. The extension should provide the effort needed to conclude the conceptual phase of the NASA Pilot Program. This ten month extension would require a $29,270 increase in funding.

Instructional Monographs produced in the NASA Pilot Program have been favorably received by educational and industrial evaluators. In addition, the objectives and program accomplishments have been reviewed by a panel of authoritative consultants. This panel gave a nearly unanimous endorsement of the usefulness of the documents to all types of students of engineering and urges the continuation of the program. The panel of consultants made several valuable suggestions for improving the program. These suggestions are the elements of investigation to be pursued in the proposed extension period. The successful investigation of these points should conclude the conceptual stage of the investigation and provide a base for obtaining funds from other agencies or private sources for the further development of this technology transfer technique.

The panel of consultants suggested that an Instructional Monograph be written to provide a more authoritative survey of a given specialized technical area. This would include subject background material.

The second suggestion was to involve some of the best informed people in a subject area in the selection of Instructional Monograph topics and prospective writers. The involvement of experts would insure the selection of appropriate and relevant topics. It would also provide a means of gaining the participation of qualified and respected people to write Instructional Monographs. A selection panel would

hopefully provide a way to reduce writing costs of Instructional Monographs with the substitution of suitable peer recognition and prestige (honorariums would be a method of remuneration).

The third suggestion was to appeal to an enlarged student audience. Instead of preparing material only for use in formal classroom instruction, it should also be prepared for use as supplementary or reference reading material by educators and engineering students and for informal study by practicing engineers.

The reports by the seven consultants provide the details of these suggestions and other important but not as significant comments. A review of the consultants' reports can provide further details. (See Quarterly Report, ER69-I-4, dated May 31, 1969.)

IV. VISUAL BRIEFS

A. Dissemination

Requests for the 21 Visual Briefs have been filled as requested from existing users or individuals who have previously requested Instructional Monographs. There are no plans to prepare additional Visual Briefs.

As previously reported, no further advertising of the Visual Briefs is contemplated. Actually, in our proposal to extend the NASA Pilot Program, there was no mention of the Visual Briefs in the Statement of Work. In discussion with the NASA Technical Monitor, Oklahoma State University has stated that they would like to terminate the program of dissemination of Visual Briefs. Approval of this request would require direction on the disposition of the Visual Briefs. Oklahoma State University would like to retain one copy of each Visual Brief for our Audio Visual Center for approximately one year.

A total of 300 requests to use the technical films have been received. There have been no requests received during this 5 month period. Film users have been slow in returning the film. Letters will be written to these individuals to encourage them to return the films. Appendix III shows the statistics on the technical films mailed to requestors.

B. Evaluations

A total of 144 evaluations have been received. Figure 3 illustrates the number of evaluations received for each Visual Brief. Seventeen Visual Briefs have been evaluated by five or more users; five evaluations for each Visual Brief were specified in the Statement of Work.

As previously reported, Visual Briefs are not requested as frequently as Instructional Monographs. However, they are favorably received by the users.

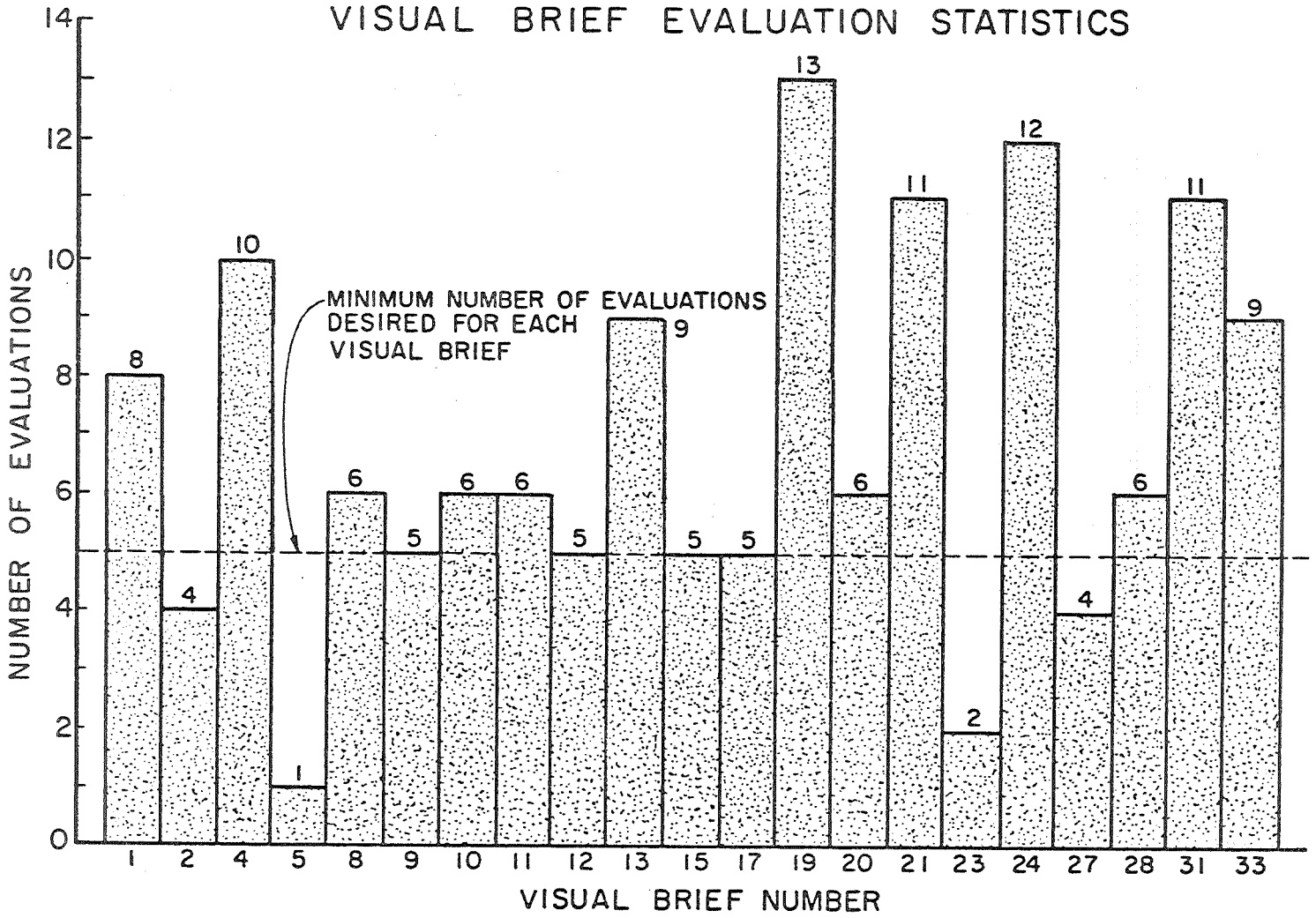
VISUAL BRIEF EVALUATION STATISTICS
NUMBER OF EVALUATIONS
VISUAL BRIEF NUMBER
MINIMUM NUMBER OF EVALUATIONS DESIRED FOR EACH VISUAL BRIEF
0
2
4
6
8
10
12
14
1 2 4 5 8 9 10 11 12 13 15 17 19 20 21 23 24 27 28 31 33
8 4 10 1 6 5 6 6 5 9 5 5 13 6 11 2 12 4 6 11 9

Figure 3

APPENDICES

APPENDIX I

UNIVERSITY MONOGRAPH DISSEMINATION STATISTICS THROUGH OCTOBER 31, 1969

Monograph Number	Instructor's Copies Sent	Student's Copies Sent	Evaluations Received
CS-1	71	273	7
CS-2	91	636	12
CS-3	86	511	13
CS-4	101	410	2
CS-5	111	478	14
CS-6	119	517	14
CS-7	5	50	1
CS-8	5	50	1
HT-1	149	631	20
HT-2	91	236	6
HT-3	123	625	16
HT-4	114	607	25
HT-5	99	181	7
HT-7	99	287	7
HT-8	83	432	5
HT-9	3	0	0
TD-1	108	445	12
TD-2	7	40	0
TD-3	115	437	15
TD-4	83	243	7
TD-5	20	76	1
TD-6	11	40	1
TD-8	8	0	0
	1,702	7,205	186

APPENDIX II

INDUSTRIAL MONOGRAPH DISSEMINATION
STATISTICS THROUGH OCTOBER 31, 1969

Dissemination Sumary by Monograph Number

Monograph Number	Instructor's Copies Sent	Student's Copies Sent	Evaluations Received
CS-1	29	0	5
CS-2	22	0	2
CS-3	42	0	5
CS-4	40	0	2
CS-5	32	0	6
CS-6	42	0	6
CS-7	0	0	0
CS-8	0	0	0
HT-1	52	16	12
HT-2	35	15	3
HT-3	44	15	3
HT-4	37	15	4
HT-5	55	15	5
HT-7	81	15	13
HT-8	64	15	7
TD-1	47	15	11
TD-2	16	0	0
TD-3	90	15	13
TD-4	38	0	7
TD-5	38	15	1
TD-6	9	0	0
TD-8	14	0	0
	827	166	105

APPENDIX III

VISUAL BRIEF DISSEMINATION STATISTICS THROUGH OCTOBER 31, 1969

Visual Brief Number	Number Sent	Unfilled Requests	Evaluations Received
VB- 1	11	0	8
VB- 2	5	1	4
VB- 4	20	5	10
VB- 5	11	0	1
VB- 8	16	8	6
VB- 9	10	0	5
VB-10	19	1	6
VB-11	9	1	6
VB-12	15	3	5
VB-13	22	7	9
VB-15	12	0	5
VB-17	9	0	5
VB-19	20	0	13
VB-20	9	1	6
VB-21	11	1	11
VB-23	6	0	2
VB-24	20	0	12
VB-27	9	0	4
VB-28	9	0	6
VB-31	17	0	11
VB-33	13	0	9
	273	27	144

APPENDIX IV

A Proposal
for
An Instructional Monograph
on
An Example of Time-Optimal Control Computation

Objective

The proposed monograph would present a computational method for time-optimal control in a form suitable for inclusion in a graduate level course in Optimal Control.

Introduction

In recent years, the solution of optimal-control problems has received a good deal of attention. Present-day methods of calculating optimal-control solutions can be grouped into two classes: direct and indirect. The direct methods minimizes the value of some functional by a comparison of values of the functional at two or more points. The indirect method minimizes the functional by means of necessary (and sometimes sufficient) conditions.

The direct methods usually rely on gradient theory. The necessary conditions for the indirect methods are determined from the Pontryagin maximum principle, calculus of variations or dynamic programming. In order to solve the problem, a nonlinear two-point boundary-value problem must be solved.

Summary

The monograph will present a successive approximation procedure for solving a class of two-point boundary-value problems resulting from the application of the Pontryagin maximum principle. The method is illustrated by determination of the time-optimal redezvous trajectories between a vehicle launched from the surface of the moon and a target in an 80-nautical-mile circular orbit about the moon.

References

The monograph will be based on a number of references. The primary sources will be:

"A Computational Method for Time'Optimal Space Rendezvous" by E. S. Armstrong and A. T. Markos, NASA TN-D-5017.

"A Combined Newton-Raphson and Gradient Parameter Correction Technique for Solution of Optimal-Control Problems" by E. S. Armstrong, NASA TR-R-293.

Budget

Salary		$1100.00
Travel	(one trip to NASA - Langley Research Center)	75.00
		$1175.00

OKLAHOMA STATE UNIVERSITY
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1891

OSU

THE COLLEGE OF ENGINEERING